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Docket No. 18036-20
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of **Lars G. SVENSSON et al.** Title: SYSTEM AND METHOD FOR POWER-EFFICIENT CHARGING AND DISCHARGING OF A CAPACITIVE LOAD FROM A SINGLE SOURCE Serial No. 08/986,327 Filed: December 5, 1997	Group Art Unit: 2838 Examiner: A. Berhane

DECLARATION OF WILLIAM C. ATHAS (RULE 132)

I, William C. Athas, declare that:

1. I am one of the inventors of this Continued Prosecution Application for a reissue patent.

2. I am a Senior Project Leader in the Information Sciences Institute and a Research Assistant Professor of the EE-Systems Department of the University of Southern California. I received a Ph.D., Masters and Bachelors degree in Computer Science from the California Institute of Technology. I have been involved in numerous research projects, published numerous papers, taught, advised, received numerous patents, and am a member of numerous professional associations related to the technology of this patent

application. More specific information about my background is set forth on the Curriculum Vitae that is attached as Exhibit 1.

3. I understand that the Examiner in this case has stated that (i)t would have been obvious to one having ordinary skill in the art [at] the time of the invention to replace the voltage source of applicants admitted prior art [in Fig. 2] with the charge storage element of Masuda, et al. in order to provide [a] steady and cost effective power source.

4. I must respectfully disagree. It is my opinion that such a substitution was not obvious and would not have been viewed as being obvious by either a person of ordinary skill or even an expert.

A Capacitor and Power Supply Perform Vastly <u>Different</u> Functions

5. Masuda et al. teaches what was well know — the use of a capacitor as a <u>component</u> of a power supply. However, Masuda et al. did not teach or even suggest the use of a capacitor <u>as</u> a power supply — a fundamental feature of the invention.

6. To be sure, there is a <u>vast</u> difference between the two.

7. The output voltage of a typical D.C. power supply remains substantially <u>constant</u> under load. Indeed, this is a defining characteristic of most power supplies. The same plainly cannot be said about a capacitor. As is well known, the output voltage of a capacitor steadily <u>declines</u> under load.

The Skilled Artisan Would Not Have Expected a Capacitor to Work

8. Because of these vast functional differences, the skilled artisan would not have expected capacitors to work in lieu of the power supplies shown in Fig. 2. Such a suggestion would have been tantamount to suggesting that a battery in a flashlight be replaced by a capacitor. How would it work?

9. Specifically, his initial reaction would be to question how voltages would be developed across the capacitors in Fig. 3, how the voltages would be set to their needed step values, and how these voltages would be maintained when current is repeatedly drained from the capacitors during the charging cycles.

Fig. 3 Functions Much Differently Than Fig. 2

10. Fig. 3 also functions much differently than Fig. 2.

11. First, the voltage that is delivered to the load CL during the first charging cycle is much different. In the prior art Fig. 2, the voltage that is delivered to the load CL during the first charging cycle progressively increases from zero to VN in N steps. The voltage that is delivered to the load CL during the first charging cycle in Fig. 3, on the other hand, has only one step, regardless of the value of N — from 0 directly to VN.

12. Unlike closure of switch 1 during the first charging cycle in Fig. 2, closure of switch 1 in Fig. 3 does not cause any increase in the voltage that is delivered to the load CL. This is because there is no charge across the capacitor 18 that is connected to switch 1 at this time. The same holds true in connection with the subsequent closures of switches 2

through N-1 during the first charging cycle. No voltage is delivered to the load CL in Fig. 3 until closure of the final switch N.

13. During the discharge portion of the cycle, there is also something much different happening. In the prior art Fig. 2, the energy stored in the load CL is typically dissipated as heat during the discharge cycle as the voltage steps downward. In Fig. 3, on the other hand, energy stored in the load CL is transferred back into the tank capacitors 18 during the discharge cycle. This transfer of energy causes a voltage to appear across these capacitors.

14. By the beginning of the second charging cycle, all of the capacitors are charged to a degree. Although they are usually still not at the levels of their corresponding supplies in Fig. 2, the voltage across each is somewhat proportional to its position in the step ladder.

15. During the second charging cycle, each of the capacitors in Fig. 3 loses some of its charge. But none are usually discharged completely.

16. During the second discharging cycle, the voltage across each capacitor again grows. This time, however, it usually grows to a higher level than during the first discharging cycle because it begins at a higher level.

17. In short, the circuits of Fig. 2 and 3 operate in a much different manner.

Experts Doubted That the Invention Would Stabilize At the Needed Levels

18. Upon seeing Fig. 3, experts in the art doubted that the voltages across the capacitors would stabilize under normal conditions to their needed values — i.e., the values of the corresponding supplies in Fig. 2.

19. We submitted an article describing the circuit shown in Fig. 3 and explaining how it worked to one of the premier scientific publications for electronic engineers, *The Journal of Solid State Circuits.* As was their custom, they submitted the article to an expert in the field for review. This expert reported that, in his opinion, the circuit would not be stable unless charging was exceedingly slow. This opinion was cited by the *Journal* as a reason for its decision not to publish our article.

20. A similar event occurred during a conference of the IEEE Symposium on Low Power Electronics in 1994. After presenting the new circuit shown in Fig. 3, I was told that Dr. John Denker — a scientist at Bell Labs working in this filed — stood up and said that, in his opinion, our circuit would not work because the voltages would not converge to their needed values.

21. In fact, mathematical computations prove that our circuit does work. Attached as Exhibit 2 is an article in which those computations are set forth.

Nothing Suggests Substituting Capacitors For All But One of the Power Supplies Shown in Fig. 2

22. Another significant difference relates to the fact that the circuit in Fig. 3 does not show a capacitor being substituted for every power supply in Fig. 2. Instead, capacitors have only

been substituted for some of these supplies. Indeed, the circuit in Fig. 3 would not work if capacitors had been substituted for every supply.

23. Nothing in Masuda, et al. teaches or suggests such a partial substitution.

The Circuit in Fig. 3 Provides New & Unexpected Results

24. The energy that is delivered to the load during each charging cycle by the typical power supplies taught in Fig. 2 is mostly dissipated as heat during each discharge cycle. This wasted energy contributes significantly to the discharge of the battery that powers the typical laptop computer.

25. The circuit in Fig. 3, on the other hand, eliminates much of this wasted energy. Instead of dissipating it as heat during the discharge cycle, it stores it in the capacitors. This stored energy is then reused during the next charging cycle.

26. This is a highly-beneficial result that is in no way taught or suggest by Masuda et al. or by Fig. 2.

Summary

27. In short, we recognized that substituting capacitors for only some of the supplies in Fig. 2 would cause the circuit to <u>operate in a vastly different manner</u> and that this vastly different manner of operation would <u>overcome the problems</u> that the skilled artisans and even the experts would and did expect and, to boot, be <u>far more energy efficient</u>.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these

statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: January 07, 2000

William C. Athas